Shelbina, Missouri
Water Supply Study
City Lake

Shelbina is located in Shelby County, Missouri.

Shelbina water supply comes from a city owned lake located about one mile North of the city. The water supply is supplemented by pumping into the lake from nearby Salt River when supplies in the lake become low. They attempt to keep the lake level within a few feet of the spillway. This analysis shows that only in dry periods would it be necessary to obtain water from the river.

Irrigation water for the golf course is taken from this lake and was not analyzed as part of this study. It was assumed that irrigation water would be replaced by pumping from the river and that the result of this would be no effect. The city operating plan is to keep the lake near full by pumping from the river.

In year 2000, the city used 127,249,000 gallon of water for municipal needs.

Average annual rainfall is 37.2 inches. Annual rainfall for 1953 through 1957 is 24.1, 33.6, 39.4, 25.59, and 47.1 inches.

Shelbina Lake analysis consisted of using the NRCS's computer program called "RESOP". This program analyses remaining stored water at the end of each month by summing gains and losses.

The following discussion is for input to the computer program by control word.

STO-AREA Elevation-Storage and Elevation-Area data were determined from July 11, 2000 survey made by USGS.

Shelbina Lake

Elevation (feet)	Area (acres)	Storage (ac-ft)	
700	4.09	4.27	
702	9.93	18.04	
704	15.35	42.73	
706	22.75	80.69	
708	27.97	131.64	
710	36.73	194.48	
712	41.50	273.75	
714	44.97	360.17	
714.3	45.68	373.75	Water Surface on 6/20/2001
715	47.06	406.25	Spillway Elevation (Fool Pool)
716	53.66	457.67	
718	63.75	575.31	
720	81.92	717.84	Top of Dam

LIMITS Full Pool storage 406 Acre Feet
Minimum Pool storage 10 Acre Feet

Starting storage was considered at Full pool.

The drainage area of the lake is 1542 acres (2.41 square miles).

GENERAL The adjustment factor of 0.76 to convert from pan evaporation to lake evaporation was applied prior to entering the data for the control word EVAP. As a result, a factor of 100 is used.

The record period of drought is in the 1950's.
Analysis began in January 1951 and ended December 1959.

SEEPAGE The reservoir seepage varied from 0 seepage near empty to a maximum of 2.50 inches per month at full pool. The seepage rate is a best estimate based on history of the reservoir, soil type, material of the core of the dam and compaction of the earth fill. The material in the dam is compacted earth of clayey soils.

RAINFALL Rainfall data came from the Shelbina, Missouri rain gage. For periods of missing data, the Shelbyville gage was used.

RUNOFF This is the runoff into the lake from its drainage area. Monthly runoff volumes in watershed inches were determined at the North River stream gage at Bethel Missouri. The drainage area is 58 square miles. The runoff was compared to the rainfall and if the results did not appear reasonable, adjustments were made for that month by looking at individual rains and estimating antecedent moisture then, adjusting runoff based on NRCS's runoff curve numbers.

EVAP. Pan evaporation at the Lakeside gaging station was used as a base because it has data for year around evaporation. This data was updated with gage data from stations at Spickard, New Franklin, and Columbia. Depending on the latest data for the station nearest to Shelbina. The adjustment factor of 0.76 to convert from pan to lake evaporation was applied at this step.

DEMAND This was determined by city records. Shelbina has a daily use of 348,627 gallons per day. Based on Year 2000 use of 127,249,000 gallons.

OTHER This refers to other inflows to the reservoir, such as pumping from Salt River into the lake. There is an 8 inch pipe line with a 30 horsepower pump that is about 0.75 miles long to pump water to the lake when the water level gets more than a few feet below the spillway. For this analysis, water was allowed to drop 6 feet below the spillway before pumping to present an extreme condition.

To assure adequate downstream flow in Salt River, two sets of data were examined. The 7-day Q-10 low flow for the period 1989 through 1999 was studied for in-stream flow requirements and this value was determined to be 2 cubic feet second. It was decided to factor the value used on Locust Creek to the drainage area on Salt River. This value was determined to be 23 cubic feet per second. Twenty three-cubic feet second was allowed to pass downstream before pumping, only on days that flow exceeded 23 cubic feet per second was pumping evaluated. The pump is rated at 600 gallons per minute.

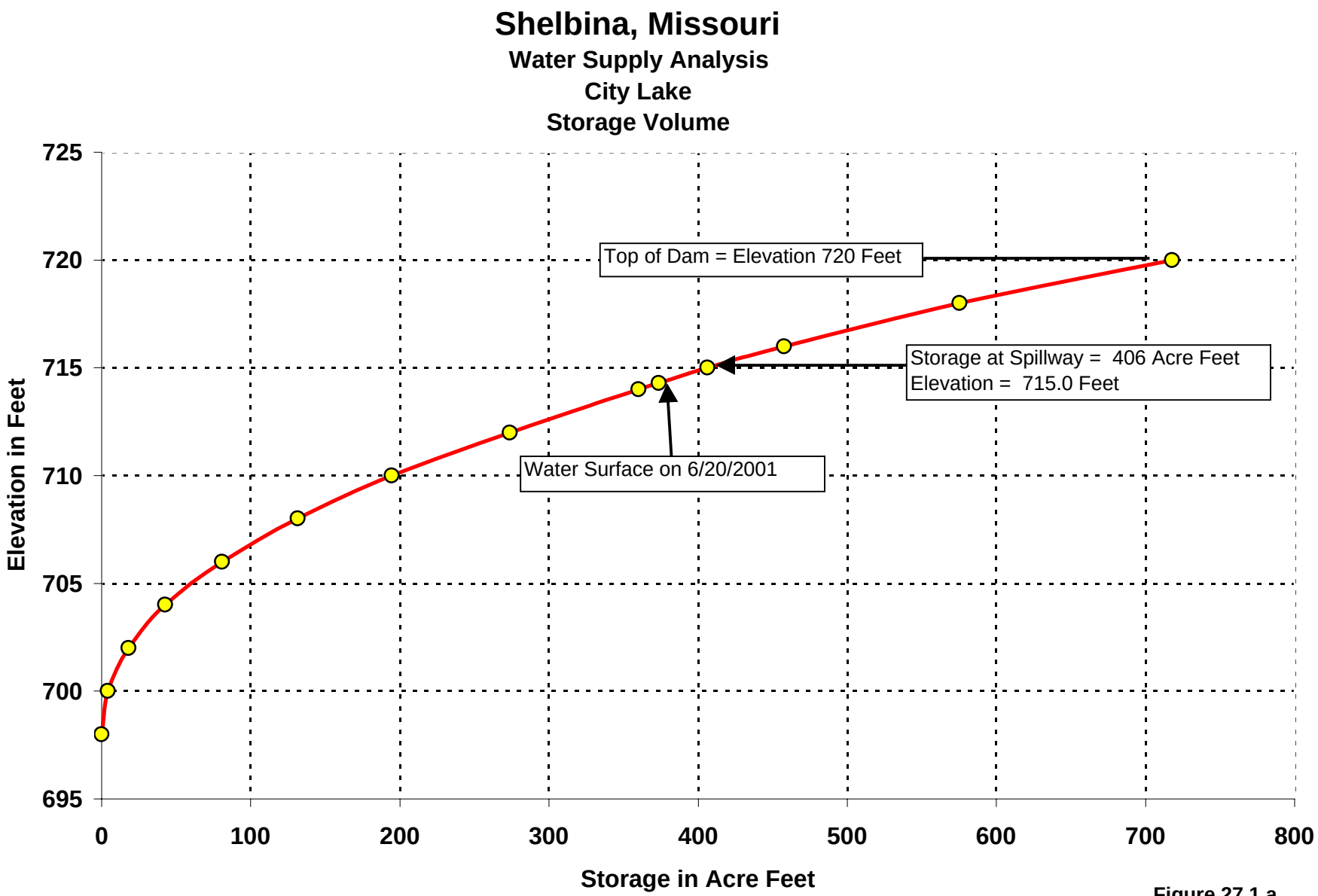

Shelbina, Missouri
Water Supply Analysis
City Lake
Storage Volume
Elevation in Feet
725
720
715
710
705
700
695
0
100
200
300
400
500
600
700
800
Storage in Acre Feet
Top of Dam = Elevation 720 Feet
Storage at Spillway = 406 Acre Feet
Elevation = 715.0 Feet
Water Surface on 6/20/2001

Figure 27.1.a

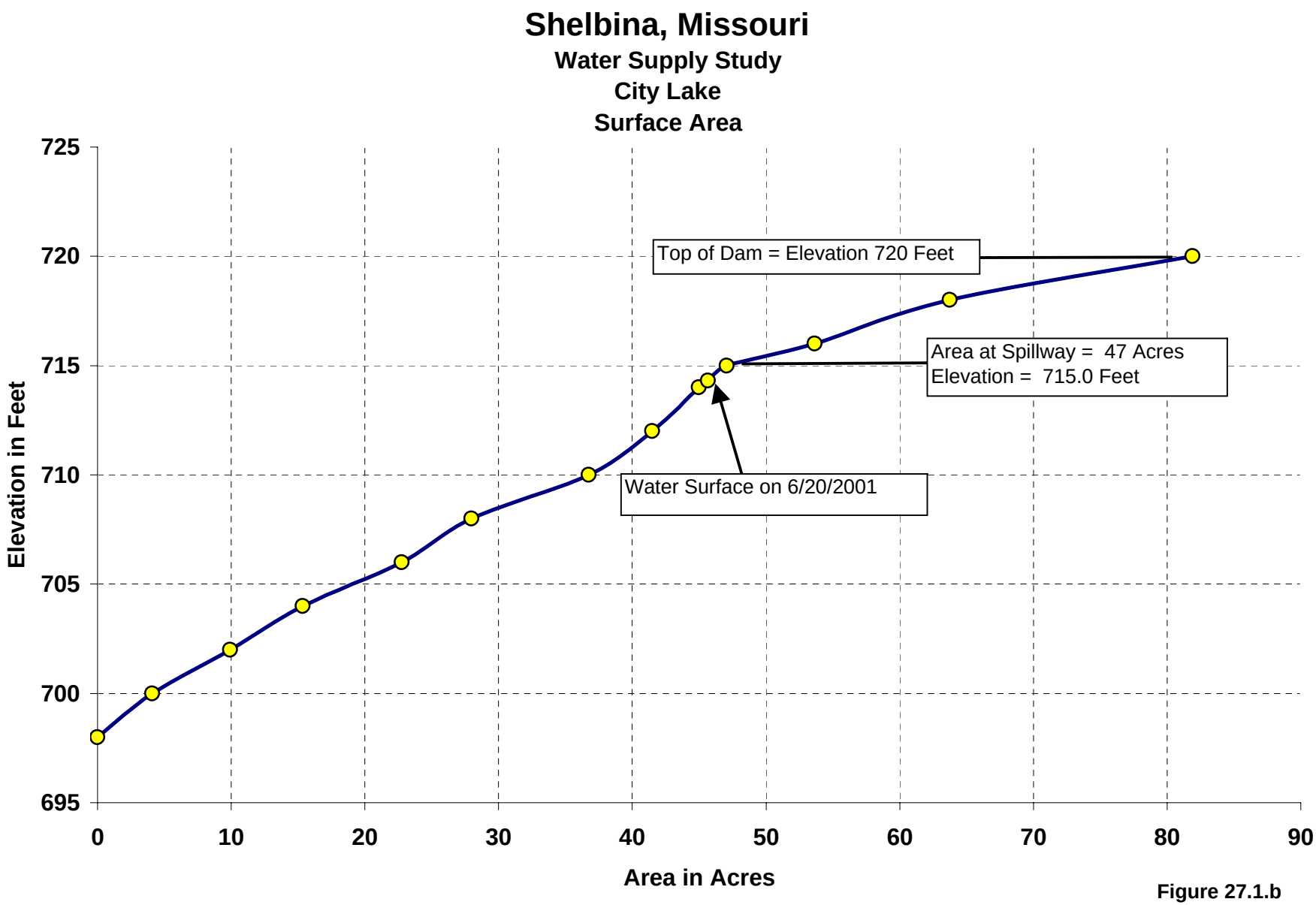

Shelbina, Missouri
Water Supply Study
City Lake
Surface Area
Elevation in Feet
725
720
715
710
705
700
695
0
10
20
30
40
50
60
70
80
90
Area in Acres
Top of Dam = Elevation 720 Feet
Area at Spillway = 47 Acres
Elevation = 715.0 Feet
Water Surface on 6/20/2001

Figure 27.1.b

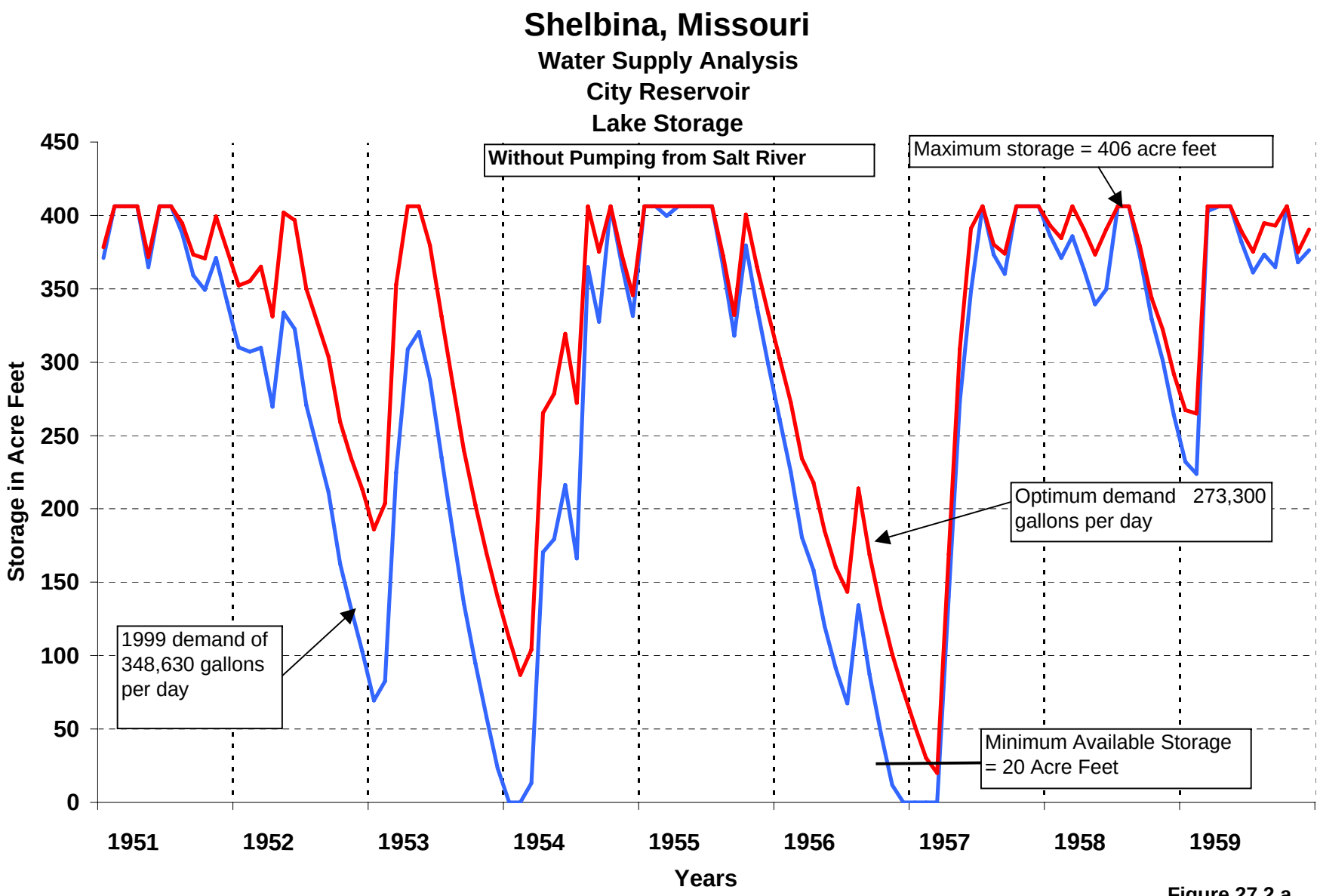

Shelbina, Missouri
Water Supply Analysis
City Reservoir
Lake Storage
Without Pumping from Salt River
Maximum storage = 406 acre feet
Optimum demand 273,300 gallons per day
1999 demand of 348,630 gallons per day
Minimum Available Storage = 20 Acre Feet
Storage in Acre Feet
450
400
350
300
250
200
150
100
50
0
1951
1952
1953
1954
1955
1956
1957
1958
1959
Years

Figure 27.2.a

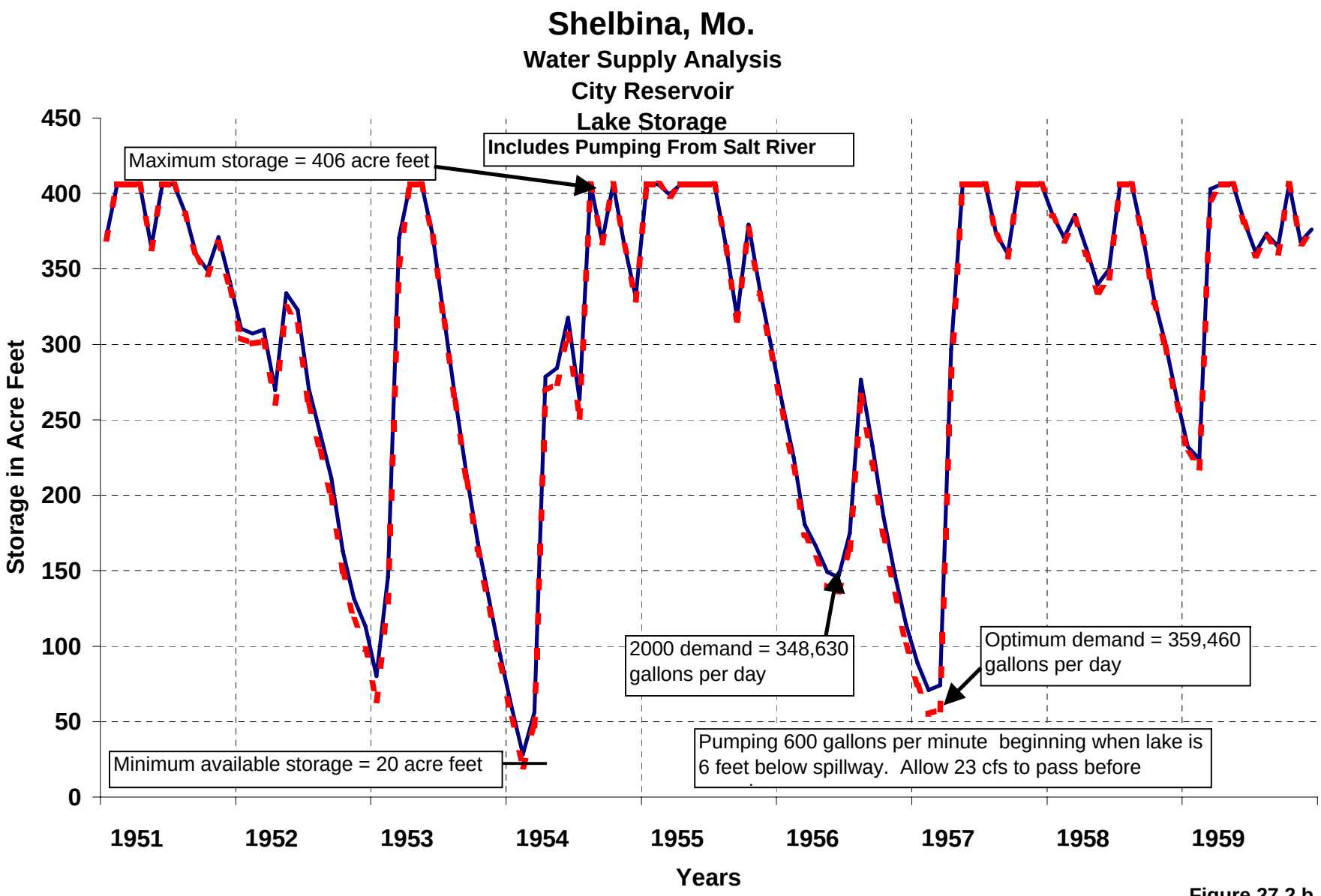

Shelbina, Mo.
Water Supply Analysis
City Reservoir
Lake Storage
Includes Pumping From Salt River
Maximum storage = 406 acre feet
2000 demand = 348,630 gallons per day
Optimum demand = 359,460 gallons per day
Pumping 600 gallons per minute beginning when lake is 6 feet below spillway. Allow 23 cfs to pass before
Minimum available storage = 20 acre feet
Storage in Acre Feet
450
400
350
300
250
200
150
100
50
0
1951
1952
1953
1954
1955
1956
1957
1958
1959
Years

Figure 27.2.b

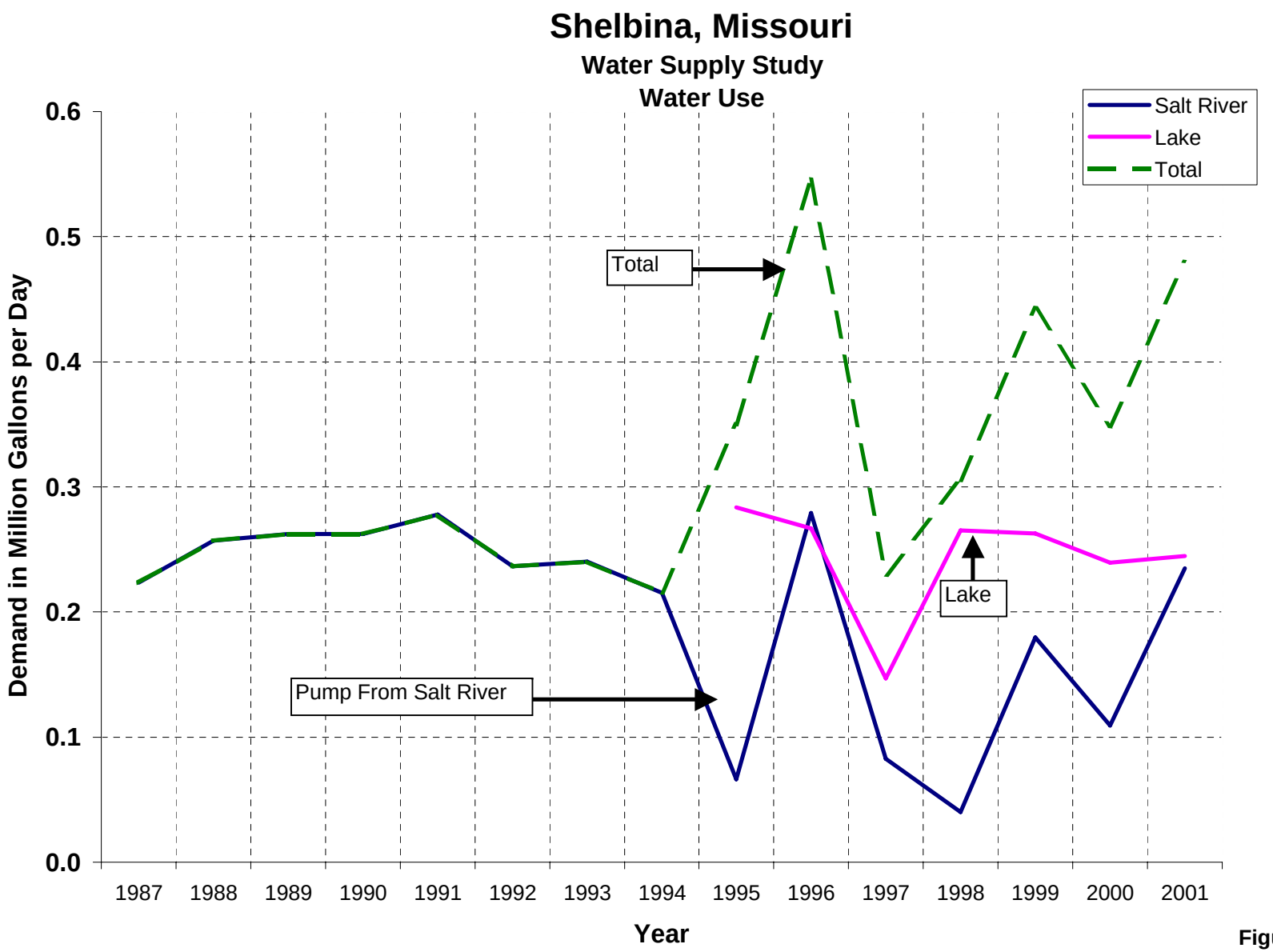
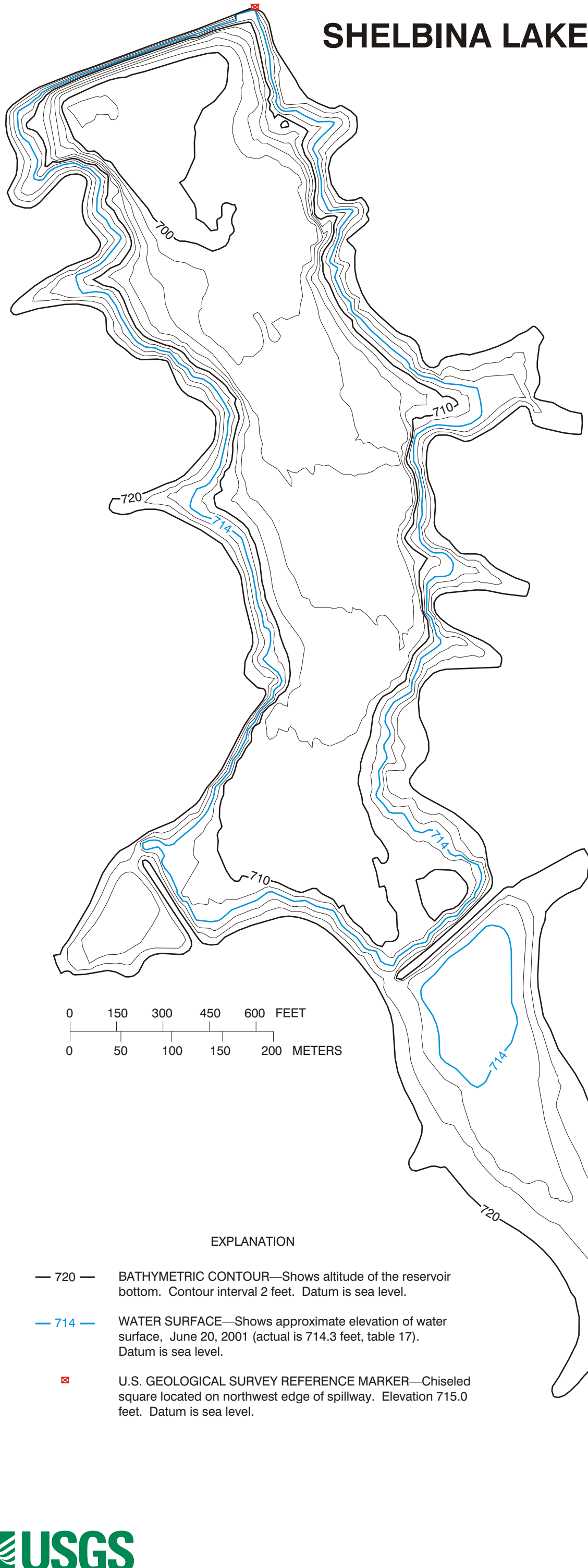
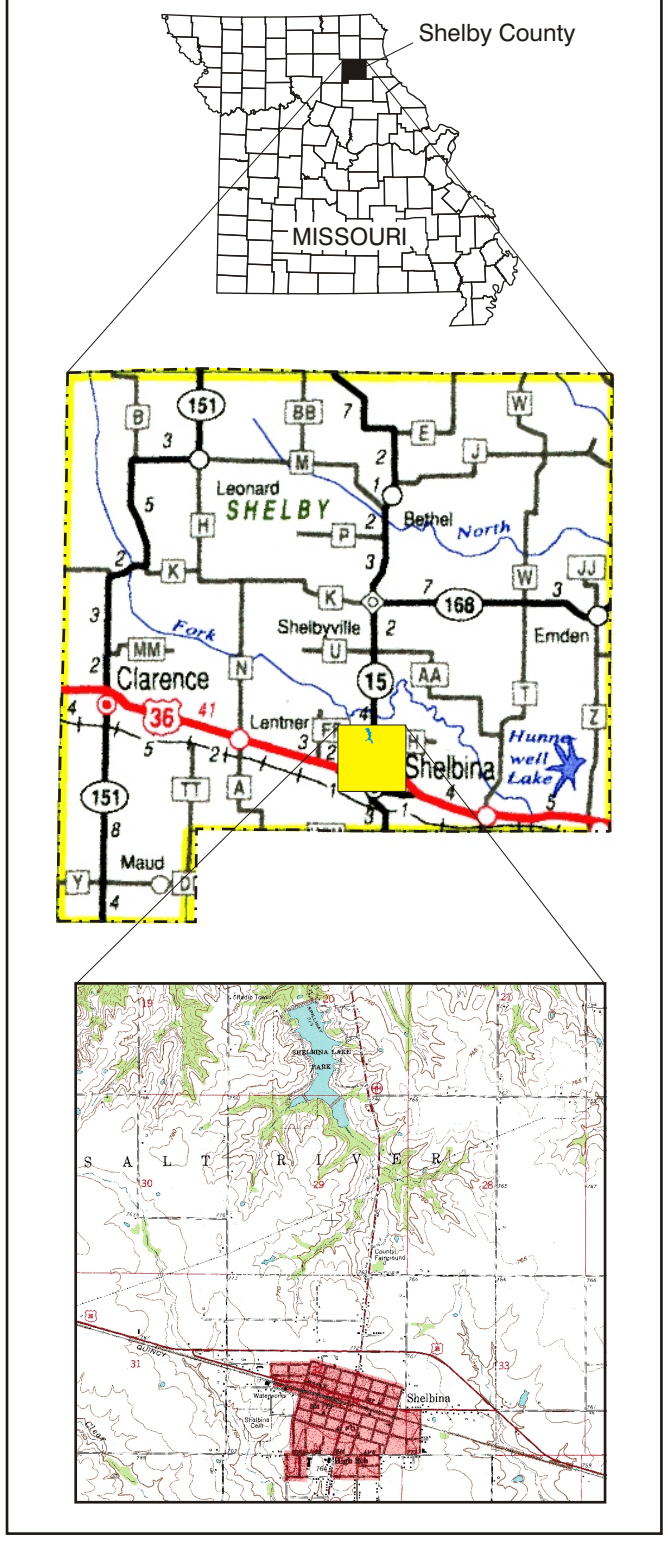

Shelbina, Missouri
Water Supply Study
Water Use
Salt River
Lake
Total
Total
Lake
Pump From Salt River
Demand in Million Gallons per Day
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
Year

Figure 27.3

SHELBINA LAKE



LOCATION MAP



Elevation (feet)	Area (acres)	Volume (acre-ft)
700.0	4.1	4.3
702.0	9.9	18.0
704.0	15.3	42.7
706.0	22.7	80.7
708.0	28.0	131.6
710.0	36.7	194.5
712.0	41.5	273.8
714.0	45.0	360.2
714.3	45.7	373.7
715.0	47.1	406.3
716.0	53.7	457.7
718.0	63.8	575.3
720.0	81.9	717.8

Table 12. Lake elevations and respective areas and volumes. Spillway elevation is 715.0 feet. Top of dam is approximately 720 feet. Datum is sea Level.

EXPLANATION

— 720 — BATHYMETRIC CONTOUR—Shows altitude of the reservoir bottom. Contour interval 2 feet. Datum is sea level.

— 714 — WATER SURFACE—Shows approximate elevation of water surface, June 20, 2001 (actual is 714.3 feet, table 17). Datum is sea level.

⊠ U.S. GEOLOGICAL SURVEY REFERENCE MARKER—Chiseled square located on northwest edge of spillway. Elevation 715.0 feet. Datum is sea level.

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Figure 27.4 Bathymetric map and table of areas/volumes of Shelbina Lake near Shelbina, Missouri.